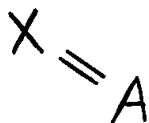


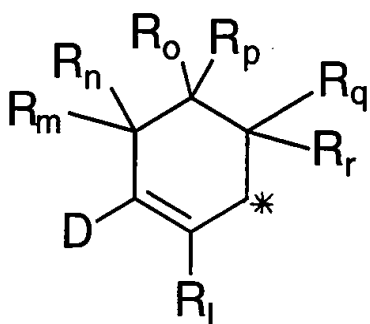
Claims

- SUB  
A1 1. A compound having a formula A:

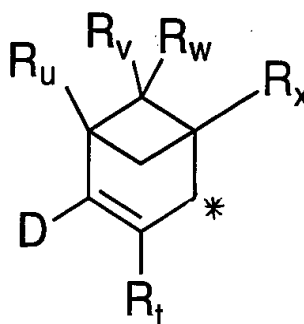


(formula A)

wherein X is selected from the group consisting of

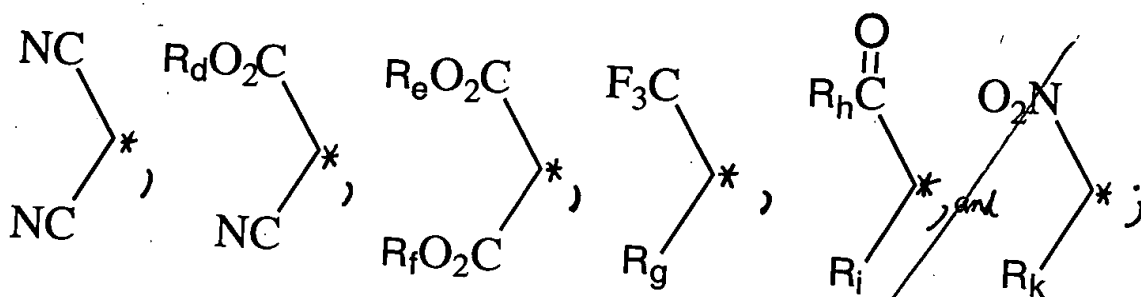


and



wherein D is selected from the group consisting of NR<sub>a</sub>R<sub>b</sub>, OR<sub>a</sub>, SR<sub>a</sub>, PR<sub>a</sub>R<sub>b</sub>, and R<sub>c</sub>;

wherein A is selected from the group consisting of:

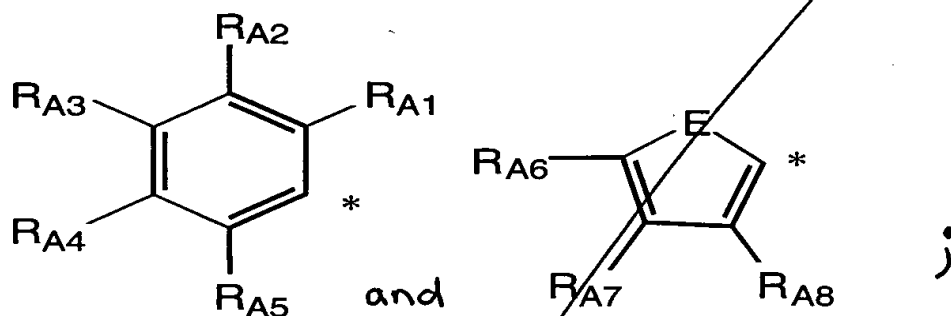


wherein  $R_a$ ,  $R_b$ , and  $R_c$  are the same or different and are each independently selected from the group consisting of: H; a linear, branched, or cyclic alkyl group;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{OR}_{A1}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{NR}_{A2}\text{R}_{A3}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{CN}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{Cl}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{Br}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{I}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{-Phenyl}$ ;  $-(\text{CH}_2)_\alpha(\text{CF}_2)_\gamma\text{CF}_3$ ; and an aryl group;

wherein  $R_d$ ,  $R_e$ ,  $R_f$ ,  $R_i$ ,  $R_m$ ,  $R_n$ ,  $R_o$ ,  $R_p$ ,  $R_q$ ,  $R_r$ ,  $R_s$ ,  $R_t$ ,  $R_u$ ,  $R_v$ ,  $R_w$ , and  $R_x$  are the same or different and are each independently selected from the group consisting of: H; a linear, branched, or cyclic hydrocarbon group that is saturated or unsaturated; a linear, branched, or cyclic alkyl group;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{OR}_{A1}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{NR}_{A2}\text{R}_{A3}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{CN}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{Cl}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{Br}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{I}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{-Phenyl}$ ;  $-(\text{CH}_2)_\alpha(\text{CF}_2)_\gamma\text{CF}_3$ ; and an aryl group;

wherein  $R_g$ ,  $R_h$ ,  $R_i$ , and  $R_k$  are the same or different and are each independently selected from the group consisting of: H; a linear, branched, or cyclic hydrocarbon group that is saturated or unsaturated; a linear, branched, or cyclic alkyl group;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{OR}_{A1}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{NR}_{A2}\text{R}_{A3}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{CN}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{Cl}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{Br}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{I}$ ;  $-(\text{CH}_2\text{CH}_2\text{O})_\alpha-(\text{CH}_2)_\beta\text{-Phenyl}$ ; an aryl group;  $-(\text{CH}_2)_\alpha(\text{CF}_2)_\gamma\text{CF}_3$ ;  $-\text{CO}_2\text{R}_d$ ; and  $-\text{COR}_d$ ;

wherein each aryl group is optionally independently selected from the group consisting of



wherein RA1, RA2, RA3, RA4, RA5, RA6, RA7, and RA8 are the same or different and are each independently selected from the group consisting of H, a linear alkyl group, a branched alkyl group, and a cyclic alkyl group;

wherein E is selected from the group consisting of S, O, and NR<sub>s</sub>;

wherein the alkyl group is optionally substituted or unsubstituted and optionally includes up to 25 carbon atoms;

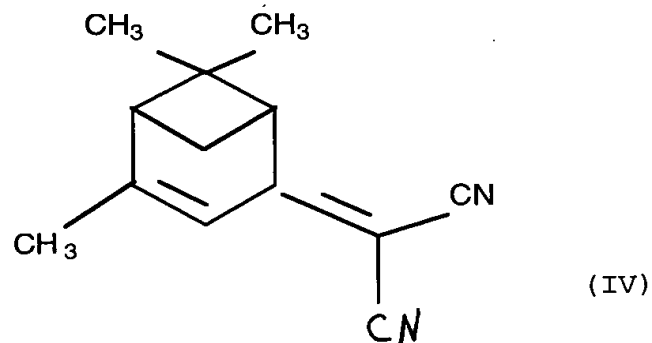
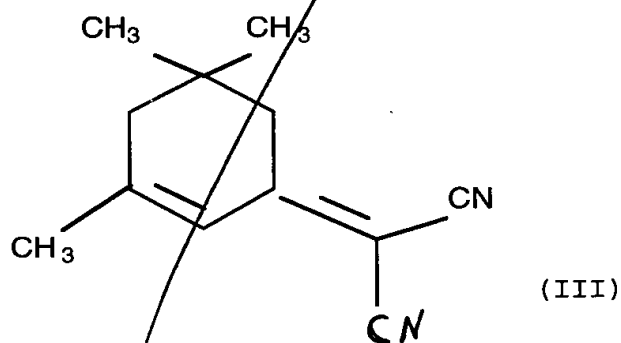
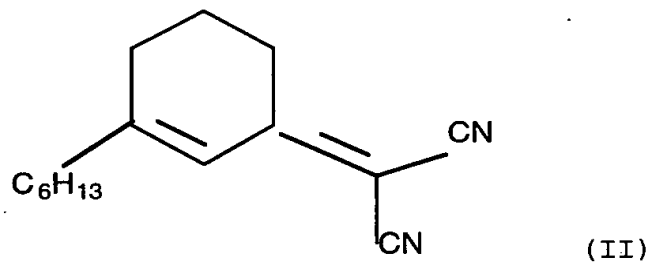
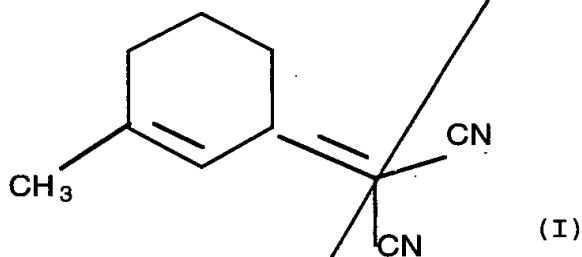
wherein  $\alpha$  is an integer that is greater than or equal to 0 and less than or equal to 25;

wherein  $\beta$  is an integer that is greater than or equal to 0 and less than or equal to 25; and

wherein  $\gamma$  is an integer that is greater than or equal to 0 and less than or equal to 25.

2. A compound as claimed in Claim 1, wherein  $R_1, R_m, R_n, R_o, R_p, R_q, R_r, R_t, R_u, R_v, R_w,$  and  $R_x$  are each H; wherein A is  $C(CN)(CN)$ ; and wherein D is  $R_y$  or  $OR_y$ , wherein  $R_y$  is selected from the group consisting of the linear alkyl group, the branched alkyl group, the cyclic alkyl group, and the aryl group.

3. A compound as claimed in Claim 1, wherein the compound is selected from the group consisting of



4. A liquid-crystal dopant comprising a compound as claimed in Claim 1.

5. A liquid-crystal dopant comprising a compound as claimed in Claim 2.

6. A liquid-crystal dopant comprising a compound as claimed in Claim 3.

7. A liquid-crystal dopant having at about 20-30°C an absorption loss in the visible region of less than or equal to about 5%; having at about 20-30°C a dielectric anisotropy of greater than about 50; and having at about 20-30°C a viscosity lower than about 50 centi-poise.

8. A composition comprising a liquid-crystal mixture and a liquid-crystal dopant as claimed in Claim 7, wherein the composition at about 20-30°C has a  $\partial n / \partial T$  larger than about 0.005, wherein  $n$  is a refractive index of the composition at a visible wavelength and  $T$  is a temperature of the composition in °C.

9. A composition comprising a liquid-crystal mixture and a compound as claimed in Claim 1.

10. A composition as claimed in Claim 9, wherein the compound comprises less than or equal to about 50% by weight of the composition.

11. A method for reducing an operation voltage of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture.

12. A method as claimed in Claim 11, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield a resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

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A6  
13. A method for tuning a clearing temperature of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture.

14. A method as claimed in Claim 13, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield a resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

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A6  
15. A method for tuning birefringence of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture.

16. A method as claimed in Claim 15, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield a resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

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17. A method for increasing a  $\partial n / \partial T$  of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture to yield a resulting mixture, wherein the resulting mixture at about 20-30°C has a  $\partial n / \partial T$  larger than about 0.005, wherein n is a refractive index of the resulting

mixture and T is a temperature of the resulting mixture in °C.

18. A method as claimed in Claim 17, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield the resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

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A8  
19. A compound as claimed in Claim 1, wherein  
wherein when D is  $\text{NR}_a\text{R}_b$ , then  $\alpha$  is greater than or equal to 1 and less than or equal to

25;

wherein when  $\text{R}_1$ ,  $\text{R}_m$ ,  $\text{R}_n$ ,  $\text{R}_q$ , and  $\text{R}_r$  are each H, and  $\text{R}_o$ ,  $\text{R}_p$ , and D are each  $-\text{CH}_3$ , A is not  $\text{C}(\text{CN})(\text{CN})$ ;

wherein when  $\text{R}_1$ ,  $\text{R}_m$ ,  $\text{R}_n$ ,  $\text{R}_o$ , and  $\text{R}_p$  are each H, and  $\text{R}_q$ ,  $\text{R}_r$ , and D are each  $-\text{CH}_3$ , A is not  $\text{C}(\text{CN})(\text{CN})$ ;

wherein when  $\text{R}_1$ ,  $\text{R}_o$ ,  $\text{R}_p$ ,  $\text{R}_q$ , and  $\text{R}_r$  are each H, and  $\text{R}_n$ ,  $\text{R}_m$ , and D are each  $-\text{CH}_3$ , A is not  $\text{C}(\text{CN})(\text{CN})$ ; and

wherein when  $\text{R}_1$ ,  $\text{R}_m$ ,  $\text{R}_n$ ,  $\text{R}_o$ ,  $\text{R}_p$ ,  $\text{R}_q$ , and  $\text{R}_r$  are each H, and D is  $-\text{CH}_3$ , A is not  $\text{C}(\text{CN})(\text{CN})$ .

20. A composition as claimed in Claim 9, wherein the composition is a liquid-crystal composition.